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ABSTRACT

This study was designed to learn if students perceived an interactive computer/videodisc learning system to represent a viable alternative to (or extension of) the conventional laboratory for learning biology skills and concepts normally taught under classroom laboratory conditions. Data were collected by questionnaire in introductory biology classes of three categorically different postsecondary institutions where students used an interactive videodisc/computer lesson on respiration and biogeography instead of the traditional laboratory investigation. Students indicated a comparatively high level of satisfaction with this strategy and consistently responded favorably to the aspects of efficiency of instructional time. These two generalizations are consistent with past computer assisted instruction research. Students found the two approaches to be equivalent to conventional laboratory instruction in the areas of general interest, understanding of basic principles, help on examinations, and attitude toward science. Students also had a strong perception that the images on the videodisc "were not real" and this factor presented perceived both advantages and disadvantages. It is inferred that the videodisc/computer technology will not likely serve as a viable substitute to the "wet" laboratory experience, but that this medium may substantially enrich the spectrum of educational experiences usually not possible in typical classroom settings. (JN)

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BIOLOGY INSTRUCTION BY INTERACTIVE VIDEODISC OR CONVENTIONAL LABORATORY: A QUALITATIVE COMPARISON

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A B S T R A C T

This study was designed to learn if students perceived an interactive computer/videodisc learning system to represent a viable alternative to (or extension of) the conventional laboratory for learning biology skills and concepts normally taught under classroom laboratory conditions. Data were collected by questionaire in introductory biology classes of three categorically different postsecondary institutions where students used an interactive videodisc/computer lesson on respiration and biogeography instead of the traditional laboratory investigation. The system consisted of a TRS-80 Model III microcomputer interfaced to a Pioneer laser disc player and a color TV monitor.

Students indicated a comparatively high level of satisfaction with this strategy and responded consistently favorably to the aspect of efficiency of instructional time. These two generalizations are consistent with past CAI research. Students found the two approaches to be equivalent to conventional laboratory instruction in the areas of general interest, understanding of basic principles, help on examinations, and attitude toward science. Students also had a strong perception that the images on the videodisc "were not real" and this factor presented perceived both advantages and disadvantages. It is inferred that the videodisc/computer technology will not likely serve as a viable substitute to the "wet" laboratory experience, but that this medium may substantially enrich the spectrum of educational experiences usually not possible in typical classroom settings.

Purpose

This study was designed to learn if an interactive computer/videodisc learning system represented a viable alternative to (or extension of) the conventional laboratory for learning biology skills and concepts normally taught under classroom laboratory conditions. The study reported here was specifically to learn about the university introductory biology students' perception of the interactive videodisc technology as a learning device including factors as ease of use, flexability, individuality, realism, efficiency, and perception of the depth of skills and concepts acquired during the activity.

Theoretical Basis

A number of justifications for computer-assisted instruction (CAI) in science education have been offered since it was first introduced about two decades ago. Among the original arguments were: economizing on laboratory facilities and materials, saving instructional time, individualization of student work, drill and practice, rapid evaluation of student response and feedback. As computers became more sophisticated, rationale extended to: highly motivating and interactive simulations and games which enrich the educational experience, being able to manipulate abstract concepts in a more concrete manner, and the ability to interact with phenomena normally not accesible in a regular classroom (Ellis, 1984). Henize-Fry, Crovello, and Novak (1984) have argued by example that CAI can operate consistent with Ausubelian learning theory. A meta-analysis of 54 studies of CAI versus traditional teaching in postsecondary classrooms revealed higher examination scores by approximately 3% favoring CAI and with effect sizes which are small but significant (about .2 S.D.) (Kulik, Kulik, and Cohen, 1980). Furthermore, these studies found CAI to have significant and remarkable saving

in instructional time.

Crovello (1984) has declared CAI in biology to currently be in a rapid growth and diversification phase. One direction of this phase is the linking of microcomputers to other recent technologies such as a laser videodisc player. A question remains: Can the videodisc player add a new and productive dimension to CAI-style instruction?

Procedure

Two rather standard laboratory investigations frequently done in university introductory biology were adapted to the interactive computer/videodisc system. Stratetgies for the development of CAI such as the principles recommended by Alessi (1984) together with television-style production procedures were employed. One investigation, entitled Respiration was a study of the effects of temperature upon the respiration rate of an organism as measured by its oxygen consumption. The students planned the experiment and selected the variables they wished to study. In the videodisc version, results of the actual apparatus and corresponding organisms were filmed under a wide range of outcomes. Also in the videodisc version, students manipulated the apparatus on the screen of the color monitor and communicated by typing into the computer keyboard and listening or viewing responses from the monitor. The second investigation, Climate and Life was a study of the relationship between worldwide climatic variables the the effects of these variables upon the distribution of world life types. The student studied and manipulated graphs, charts, photographs and maps in the conventional exercise. The videodisc version contained similar data, but also high-quality video motion sequences of organisms in major biomes of the world. The task in both cases was to infer life types, given climatic patterns and vise versa.

Instrumentally, the interactive videodisc/computer system consisted of a TRS-80 Model III microcomputer interfaced to a Pioneer laser disc player and a 13-inch color TV monitor. All but the interface have been available for at least ten years, but this specific interface device was not developed until 1982 by the Nebraska Videodisc engineering group. Thus, this system represents very new technology. The microcomputer provided the characteristic interactivity of CAI, while the videodisc player allowed the user to retreive instantly a library of high-quality video sequences or simulations and to use these sequences as "real life" data sources in their investigations.

The study sites were three quite different post-secondary institutions: U.C. Berkeley, University of Nebraska, and Emporia State College. Random laboratory sections of introductory biology students were selected for either the conventional laboratory treatment (Respiration N=72 and Climate and Life N=79) or the interactive videodisc treatment (Respiration N=95 and Climate & Life N=135). The main limiting factor on the number of students available for the study was that interactive videodisc systems cost approximately $5,000 each and using one at each study site allowed only a limited number of students to use the system over the period of a semester. To control for other possible variables, the conventional laboratory group and the videodisc group did the investigations in the same sequence and at the same time during the Fall Semester, 1983. Both groups were allowed 3 hours to complete each activity and both groups completed a laboratory report which was subsequently graded. All students in the study attended the same lectures and did all the same other assignments (including laboratory work).

Upon completion of each laboratory or videodisc activity, each student answered a 3-page questionaire. The questionaire contained items to assess the student's satisfaction with, interest in, and appraisal of the educational value of the activity. Some items were common to the questionaire

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given to both the videodisc and conventional laboratory groups and some questions were specific to each mode of instruction. Five-choice "strongly agree" to "strongly disagree" or "very effective" to "very ineffective" were used for most measures where a relative judgment was requested. The questionaire contained other specific questions, as well as an invitation to the student for non-specific written comments.

Results and Conclusions

RESPONSES OF QUESTIONS GIVEN TO BOTH GROUPS

Although questionaire results for Respiration and for Climate and Life had some minor differences, data patterns for both were similar enough that generalizations derrived can apply to both lessons. Table 1 gives summarizes student reaction data from derived from the questionaires. Multiple t-tests were employed to assess significance of differences between responses by students completing the tradational laboratory activities and the students completing the interactive videodisc lessons. Students using the interactive videodisc had significantly more positive responses on the following measures than students doing the conventional laboratory investigations: (1) efficiency of time spent on the activity, (2) level of attention to lesson, (3) effect in understanding results of the experiment, (4) confidence in following instructions, and (5) general satisfaction with what was learned. No significant differences were reported between groups for the following measures: (1) general interest in the lesson, (2) effect in understanding basic principles, (3) confidence conducting the experiment, (4) boredom level, (5) confusion level, (6) change in interest toward science, (7) value in helping on exams, and (7) helping understand in areas of perceived difficulty. For no measures where there significantly more positive responses by the conventional laboratory group.

Table 1. Comparative Student Reactions between Tradational Laboratory and Interactive Videodisc Lessons

RESPONSE VARIABLE	RESPIRATION LESSON						CLIMATE AND LIFE LESSON					
	Convent. (N=72)		Videodisc (N=95)				Convent. (N=79)		Videodisc (N=135)			
	Mean	S D	Mean	S D	t	Sig	Mean	S D	Mean	S D	t	Sig
1. Time spend on lesson (minutes):												
a. In outside preparation	34.0	22.	6.0	7.9	10.4	<.01	34	13.2	17	32.3	5.4	<.01
b. Working in class	119	42.	72	30.	8.0	<.01	119	34.1	100	38.3	3.7	<.01
c. Writing the report	43.0	19.	23.	14.5	7.4	<.01	43	28.5	17	2.9	8.1	<.01
2. Attention level to activity (1-5)*	3.2	.75	3.4	.96	1.5		3.2	.86	3.8	1.4	3.9	<.01
3. Interest in lesson content (1-5)*	3.2	1.1	3.4	1.1	1.1		3.2	.97	3.4	1.3	.18	
4. Effectiveness in helping (1-5)												
a. understand data & results	2.8	1.1	3.5	1.1	4.2	<.01	2.8	1.0	3.1	1.0	2.1	<.01
b. understand basic principles	3.5	.99	3.6	1.1	.62		3.5	.90	3.5	1.0	0	
5. Confidence in doing lesson (1-5)*												
a. using equipment/hardware	3.7	.91	3.8	1.2	.61		3.7	1.1	3.6	1.3	.60	
b. conducting investigation	3.6	.99	3.6	1.0	0		3.6	.97	3.4	1.1	1.4	
c. reporting results	3.4	.98	3.6	1.0	1.3		3.4	1.1	3.1	1.3	1.8	<.01
d. following instructions	3.2	1.0	4.0	1.0	5.1	<.01	3.2	1.0	4.0	1.2	5.2	<.01
6. Learned what was expected (1-5)*	3.4	1.2	3.5	1.1	.55		3.4	1.2	3.4	1.1	0	
7. Satisfied with learning (1-5)*	2.6	1.0	3.6	.96	6.5	<.01	2.6	.89	3.2	1.1	4.17	<.01
8. Level of boredom for lesson (1-5)*	2.4	1.2	2.5	.98	.59		2.4	.97	2.2	1.1	1.38	
9. Level of confusion (1-5)*	2.4	1.3	2.1	1.1	1.58		2.4	.96	2.2	1.0	1.45	
10. Level at which lesson increased my interest in science (1-5)*	2.4	.87	2.4	1.1	0		2.4	1.1	2.3	1.0	.77	

*Scales of 1 --> 5 were used with 1 representing the least positive response and 5 representing the most positive response.

RESPONSES OF STUDENTS USING THE INTERACTIVE VIDEODISC ONLY

The videodicc user group gave relatively high ratings to (1) the opportunity to work at their own pace, (2) visual quality, (3) the lack of burdensome text, (4) ease of concentration, and (5) the opportunity for feedback on answers. Relative non-commited responses were given for (1) would rather learn in a conventional laboratory, (2) could learn more from a "real" experiment, (3) would like more lessons on the videodisc, and (4) lesson was challenging. There were no cases where relatively low ratings were given to the interactive videodisc experience.

Frequent positive comments from this group were to the effect that (1) "It doesn't matter if you make a mistake on the computer because it is not real like in the lab", (2) "I can gather data more quickly", (3) "I don't have to wait around", (4) "There are fewer disruptions from other students", and (5) "We can do more (variables, organisms, biomes) in the same period of time". Frequent suggestions for improvement were: (1) "Slow down the narration, (2) "Quiz questions were vague", (3) "Could learn as much by reading a text", (4) "Need better explanations", (5) "The repeat visuals are the same each time", and (5) "The ruler was hard to see and read on the TV screen" (Respiration).

RESPONSES OF THOSE DOING THE CONVENTIONAL LABORATORY INVESTIGATIONS ONLY

Relatively non-commited responses were given to a perceived effect of increasing understanding of laboratory concepts and to the notion that simulations would be just as effective as the laboratory. Students perceived setting up the experiment as not a problem. Frequent positive comments from this group included (1) "I liked actually seeing the real organism and handling the actual apparatus", (2) "It was easy (biome lab)", (3) "I liked getting negative results" (Respiration), and (4) "It was interesting". Frequent comments for improving the lesson were: (1) "There were too many

graphs to plot", (2) "It is too noisy to concentrate", (3) "We need more time", and (4) "Make sure the peas are dead".

Implications for Science Teaching

The interactive videodisc system appears to have definite promise in science instruction. Students indicated a comparatively high level of satisfaction with this strategy and responded consistently favorably to the aspect of efficiency of instructional time. These two generalizations are consistent with past CAI research. Students perceived the two strategies to be essentially equivalent on other measures, such as interest level, understanding of principles, value in helping on examinations, and attitude toward science. Students also had a strong perception that the images on the videodisc were not "real". This was thought by students to be an advantage in that procedural or decision-based mistakes would not be as consequential, but a disadvantage in that they appeared to prefer manipulating the real apparatus, organism, map, etc. It is inferred that the videodisc/computer technology will not likely serve to substitute completely the "wet" laboratory experience, but that this medium may substantially enrich the spectrum of educational experiences usually not possible in typical classroom settings. Continued use of this and other appropriate technology for science education should be explored.

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